

RE Approach for e-Business Advantage

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Abstract. As a means of contributing to the achievement of business advantage for companies engaging in e-business, we propose a requirements engineering approach that incorporates a business strategy dimension. We employ both goal modeling and Jackson's Problem Frames approach to achieve this. Jackson's context diagrams, used to represent the business model context, are integrated with goal-models to describe the complete business strategy. We leverage the paradigm of projection in both approaches while maintaining traceability to high-level business objectives as a means of simultaneously decomposing both the optative and indicative parts of the requirements problem, from an abstract business level to concrete system requirements. We integrate use of role activity diagrams to describe business processes in detail where needed.

1 Introduction

Much evidence indicates that companies are able to gain business advantage over their direct competitors via strategies that leverage IT [1-8]; however, this advantage is only made sustainable through managerial skills in understanding how to use IT as part of a greater strategy for competitive advantage, rather than by superior IT infrastructure or competency of IT staff alone [9, 10]. Organizations thus face many challenges in order to achieve sustainable business advantage over their competitors: they must not only devise effective business strategies, but it is critical that they ensure their IT systems are in harmony with and provide support for their business strategy [11].

An e-business system enables marketing, buying, selling, delivering, servicing, and paying for products, services, and information, primarily across nonproprietary networks, in order to link an enterprise with other *participants* (i.e., current and target customers, agents, suppliers, and business partners) [12]. One of the challenges of enabling business advantage in an organization's e-business initiative is ensuring that the e-business system in fact addresses the real-world problems the business intends to solve. This means understanding the activities and *business processes* through which the organization intends to generate value; i.e., its business strategy [11]. Business strategy is thus within the bounds of the problem domain of e-business systems.

We do not propose that requirements engineers should create an organization's business strategy for competitive advantage. However, requirements engineers can contribute to an organization's business advantage by ensuring that requirements of e-business systems align with, support, and enable its business strategy. To achieve this, requirements engineers must at least understand the business strategy, and have a means of representing strategic context within the requirements engineering framework. Unfortunately, few requirements engineering approaches adequately incorporate the representation of business strategy, or sufficient means for describing business processes that support the strategy.

We thus propose a requirements engineering approach for e-business systems that incorporates business strategy and business process dimensions as a means of contributing to a company's achievement of business advantage. Our approach integrates Jackson's *problem diagrams* [13] with goal modeling. We employ Jackson's *context diagrams* to describe business problem context, and goal-modeling to capture all optative properties of the system, including business goals, strategic objectives, activities and any other business or systems requirements. We leverage the paradigm of projection in both approaches as a means of simultaneously decomposing both the optative and indicative parts of the requirements problem down to the *machine*. We use role activity diagrams to model business processes where needed.

This paper is a short version of a longer technical paper [14]. The technical paper, in addition to the approach discussed in this paper, also presents a background literature survey and the application of the approach to a real e-business case taken from the literature. We recommend that the reader also refer to the technical paper.

The rest of this paper describes our approach to requirements engineering, and is organized as follows: section 2 justifies application of the Problem Frames approach to business strategy. Section 3 discusses both the idea of a *progression of problems* and why it is appropriate to the e-business domain as a means of expressing context. Section 4 shows how goal modeling can represent the requirement set. Section 5 integrates role activity diagrams to describe business processes. Section 6 presents some conclusions.

2 Business Strategy as Problem Diagrams

Based on a broad survey of research literature in business strategy, Oliver defines business strategy as "the understanding of an industry structure and dynamics, determining the organization's relative position in that industry and taking action either to change the industry's structure or the organization's position to improve organizational results" [15].

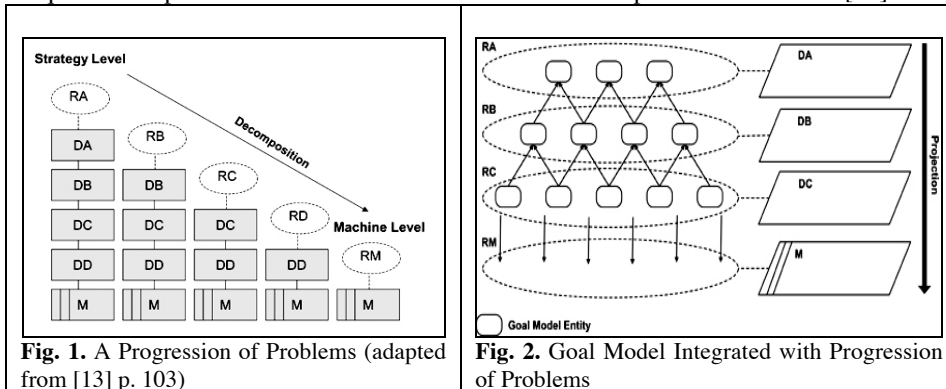
This definition of strategy is similar to Jackson's definition of a *problem diagram*. Jackson describes the world in two ways; the way the world is (*indicative* mood, i.e. the problem context) and the way in which we want to change the world (*optative* mood, i.e. the requirements) [13, 16]. Oliver's "understanding of an industry structure and dynamics," and "determining the organization's relative position in that industry" is Jackson's *indicative* mood. "Taking action either to change the industry's structure

or the organization's position to improve organizational results," is Jackson's *optative* mood, the way in which the organization desires to change the real world.

We propose that an e-business strategy can be represented as a *problem diagram*, in which the e-business system is represented as the *machine*. We recognize that an e-business system is in fact a collection of many machines working in concert, but at this level of abstraction, we represent the entire system as one *machine*, in accordance with Jackson's rule [13]. The participants in an e-business system represent *domains of interest* [13, 16]. As noted above, the *requirements* are the *optative* part of the strategy; i.e., the objectives, activities, and business processes of the firm through which it attempts to succeed in its business. We consider all optative properties of a system to be requirements, including business goals, objectives, activities, business processes, policies, and any other business or systems requirements.

3 A Progression of Problems

E-business problems at the highest level of business strategy are in fact very distant from the *machine*. To refine requirements from high-levels of abstraction down to the *machine*, the paradigm of a *progression of problems* is particularly useful (Fig. 1 below). The complexity of e-business systems as well as the need to align requirements with the highest levels of business strategy has in fact pushed the requirements problem into what Jackson describes as "deep in the real world" [13].



The *domain* DA in Fig. 1 represents the *indicative* properties of the e-business problem context at the level of business strategy. *Requirement* RA represents the *optative* properties of strategy. Through analysis of DA and RA, it is possible to find a requirement RB that refers only to DB while satisfying RA [13]. DB represents the projection of DA, but at a lower level of abstraction. Through this process of analysis, problem projection, and refinement, ultimately the requirement refers just to the *machine*.

While the paradigm of a *progression of problems* serves as a powerful framework for decomposing e-business strategy down to *machine* requirements, the Problem Frames approach provides little explicit linkage between requirements at different levels of the progression. In the example above, requirement RB must satisfy requirement RA, and RC must satisfy RB, which satisfies RA, and so on. In order to

ensure that system requirements are indeed in harmony with and provide support for business strategy, explicit traceability from lower level requirements to the highest level is necessary; however, while Jackson proposes analysis of DA and RA in order to find RB [13], a framework for doing so is not described. Moreover, the Problem Frames approach provides no direct linkages between RA and RB.

4 Integrating Goal Modeling with Progression of Problems

Goal modeling is a useful technique to describe explicit linkages between lower-level requirements and higher-level objectives [17], and therefore using goal-models to represent the requirements part of the problem diagram is a possible means to trace requirements between problem diagrams in progression. Goals represent objectives that the system ought to achieve, and refer to properties that are intended to be ensured [18]. Goals are thus requirements at a higher level of abstraction. Therefore, we treat goals as *optative*, as we would a requirement, equally bounded by the problem domain [13, 16]. Goals may be formulated at different levels of abstraction, from high-level strategic concerns to low-level technical ones [17]. This is a useful tool in describing the requirements part of problem diagrams when developing e-business systems. We therefore propose the integration of goal modeling with problem frames as a means of helping ensure that the requirements are in harmony with and provide support for business strategy.

The integration of a goal model with a progression of problems is illustrated in Fig. 2 above. The optative requirements at each level are described in terms of a portion of a larger goal model. The goal portions represent requirements at a level of abstraction equivalent to that of the *domain* to which they refer within the progression of problems. Each goal entity refers to specific *domains of interest* within the referred domain. The goal model enables explicit connections to requirements at adjacent levels in terms of super goals and sub goals. The sub goals are in fact projections of their super goals, and satisfaction of the sub goals guarantees satisfaction of the super goals in the same way that satisfaction of RB guarantees satisfaction of RA (Fig. 2). The context diagrams in the progression of problems (DA, DB, DC, ...) complement the goal model by providing problem context at various levels of abstraction with explicit linkage to requirements. Moreover, the integration of context diagrams with goal modeling also improves manageability of goal models of complex systems. The sub problems enable a decomposition of the requirements, represented as portions of the goal model, into manageable chunks, while still maintaining explicit linkages. Also, individual business goal entities are situated in the context of the problems at explicit levels of problem abstraction.

5 Business Process Model

Jackson's problem diagrams, even when augmented with goal models, are inadequate for describing business processes. While we can represent discrete activities that make up a process as optative properties of a problem, there is no notion of order in problem diagrams or goal modeling to enable description of these activities as a

process. In addition, goal models when decomposed down to the level of atomic activities in a process bloat at the bottom-level and become unmanageable. We thus propose integrating business process modeling (BPM) to alleviate the above concerns (Fig. 3).

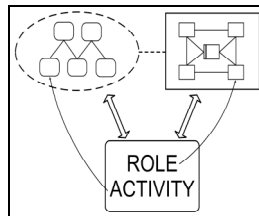


Fig. 3. RAD Providing Business Process Detail to Problem Diagram

A role activity diagram (RAD) describes business processes in great detail, including both indicative and optative properties, in a clear and succinct manner [19]. The roles represent domains of interest, and are indicative properties. The activities, which are actions and interactions between roles, represent optative properties. The goals that business processes achieve are represented in the goal model.

It might be argued that if we can show both indicative and optative properties in a business process model, this would then be sufficient on its own in describing an e-business problem; however, business processes only describe discrete goals that the process's activities achieve [20]. Without the wider perspective of the goal model there is no notion of where the process fits in the overall business strategy. Also, while describing business process is important to certain aspects of the e-business problem, not all aspects of the problem involve processes.

6 Conclusion

In this paper, we present an integration of recognized requirements engineering approaches to meet the needs of the e-business systems domain. Problem diagrams provide context for the indicative business problem and can be projected down to system requirements. Coupled with this, goal modeling captures the optative requirements that fit the problem context. Each projected sublevel of the goal hierarchy in itself represents the requirements set for the context at that level in the projection. When appropriate, we use business process models to describe the optative and indicative properties of the e-business system.

Jackson describes a requirement as “the effects in the problem domain that your customer wants the machine to guarantee” [13]. Organizations engaging in e-business rely on their systems to enable their strategy and gain business advantage. It is thus at the level of strategy that such companies bound the requirements problem for their e-business systems. While we do not propose that requirements engineers make business strategy, they can contribute to achievement of business advantage by ensuring that IT systems requirements are aligned with, provide support for, and enable business strategy.

While the approach we propose is based on research that is still in its early stages, the integration of the Problem Frames approach, goal-oriented modeling techniques,

and business process modeling may offer promise as a requirements engineering tool for e-business systems.

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